

# The SMAP Mission Applications Focus Session for Arizona State University's Modeling Community

## February 16, 2012

---

Vanessa M. Escobar, Molly E. Brown, M. Susan Moran

### Executive Summary

Applications for SMAP cut across multiple disciplines and the ASU Modelers Focus Session highlights how soil moisture products can be used in urban modeling and urban water management research. Products may offer an effective means to better monitor vulnerable conditions, such as water resources availability under the stress of climate change, and those that would trigger changes to long term plans and decisions. Applying observational data like SMAP can be seen as a dynamic strategy designed to compliment and support research models in urban areas designed to simulate plausible future conditions. Therefore preparing communities such as this with prelaunch test algorithms will bring value to the mission's post launch applications and data implementation as well as strengthen the relationships and future opportunities for unique and innovative research for soil moisture applications.

### Purpose

The SMAP mission is engaging user groups by concentrating on the thematic applications of SMAP products to better understand how specific user communities will use SMAP data. The Arizona State University SMAP Modelers Focus Session was hosted by Arizona State University's Geography Department and the Consortium for Science and Policy Outcomes, and Co-Hosted by the SMAP Applications Team. The one-day event took place on February 16, 2012 at the Global Institute of Sustainability (GIOS) in Tempe Arizona. The discussion concentrated on modeling urban water resources and demonstrating how climate change will impact the future of the developed cities. The goal was to outline the efficacy of future soil moisture observations, test algorithms prior to the launch of SMAP, and discuss the potential improvements in model outputs geared towards decision-making and policy.

The goals of the ASU Modelers Focus Session were to:

- a) Assess the value of SMAP in relation to water resource management in world's dry regions;
- b) Format of the data and its delivery mechanism, to ensure rapid ingestion of SMAP after its 2014 launch;

- c) Challenges and opportunities related to the use of SMAP data; and
- d) Explore possibilities for collaborative research between NASA and ASU.

The agenda of the session can be found at the end of this report. The day began with ASU community presentations, and continued in the afternoon with presentations SMAP representatives on pre-launch test algorithms and post launch data.

The presentations from the ASU Community included:

- ***Water Resources and Policy (WaterSim)-David Sampson***
  - Interested in using soil moisture for the Arizona municipal water supply model. Also interested in GRACE data and an early adopter program that incorporated the use of both missions. Sampson's product will provide state and municipal water officials with tools for decision making under uncertainty (supply and demand) and energy budgets in urban settings

*How will this bring value to SMAP mission:*

  - The state of Arizona's groundwater model (Salt River and Verde River Model) does not use soil moisture observations to calculate evapotranspiration. Soil moisture and other remote sensing observation data (such as Gravity from GRACE) would improve the understanding of available water supplies, recharge and runoff for the urbanized Phoenix water management area (better known as the Phoenix Active Management Area or the PHX AMA). Soil moisture would enable better decisions regarding water management and drought mitigation.
- ***Hydrology (tRIBS)- Enrique Vivoni and Agustin Robles***
  - The TIN-based Real-Time Integrated Basin Simulator (tRIBS) model emphasizes the dynamic relationship between a partially saturated vadose zone and the land surface response to the continuous storm and interstorm cycle. (Triangulated irregular networks (TINs) serve to integrate information on the surface topography, hydrographic features and land surface characteristics into an adaptive representation of a basin and has been used by SMAP SDT Scientist Dara Entekhabi). Vivoni's research group is interested in partitioning soil moisture products into latent heat for carbon cycle research in Sonora Mexico. The group currently uses Ease Grid projection for their modeling research and would be ready contribute feedback and suggestions to the SMAP mission as an Early Adopter. As collaborator of the soil moisture validation experiment SMAPEX'04, Vivoni currently uses mean soil moisture estimate from ground observations for his tRIBS model, as well as extraction of soil texture, land and vegetation values with Land Sat to produce Dry vs. Wet periods of soil moisture forgings from the model. Vivoni's use of soil moisture products would result in the following contributions:
    - Test SMAP Fields with data from multi sites

- Deploy statistical downscaling model for SMAP data
- Use downscaling to generate products for modeling data assimilation

*How will this bring value to SMAP mission:*

- tRIBS-relies on physically based models in Mexico to create information. Vivoni proposes using Sonora Mexico for a Cal/Val site (fly over with PALS). Sonora would provide an arid area as well as exploit monsoons to derive parameters for arid areas in order to understand the dynamics of the arid areas and the diversity of the arid areas.

- ***Climate Modeling-Uei Ping Huang***

- Huang's modeling effort is geared towards prediction of Hydro climate in the Americas. Huang uses two global climate models-one for atmosphere and one for oceans to develop short-term predictions (from 1 day to weeks). There are some data missing from Huang's model, to include remote sensing observations. The use of TRMM, GPM and SMAP will prove to be valuable in drought forecasting and hind cast modeling, land predictions and climate downsizing of arid areas. The modeling development is progressing and remote sensing data will increase the value of the potential products.

*How will this bring value to SMAP mission:*

- Broaden the user community's uptake of remote sensing products.

- ***Coupled land-surface model – Matei (Alex) Georgescu***

- Climate modeling and hydrodynamics over the Phoenix urban area is very important. Understanding the hydrology and heterogeneity of a city is important for long-term sustainability as well. These initializations of the models are also critical. The land-surface modeling looks at biofuel expansions and looking into second-generation biofuels; researching the direct impacts of the landscape conversion. By substituting a bio energy crop with another crop, what is the local and regional scale impact.

*How will this bring value to SMAP mission:*

- Soil moisture is a critical component as the physical mechanism for evaporation. With soil moisture observation from SMAP, it is possible to calculate the evaporation and the cooling of climate to be more accurate than what is used currently. Soil moisture will also help improve the parameterization of land surface models. Real soil moisture observations are needed to improve models that pertain to the nexus of energy and climate. Soil moisture is the starting point and it will improve the outputs of all model calculations, increasing the value of the measurements for the broader scientific community.

- ***LUCC-Suo Myint***

- Myint's research is concentrated in the Phoenix Active Management Area and focuses on the understanding of land use and land cover for developed and urbanized area of the valley. The scale looks at the

different groups of land use and land cover for drought and wet year's water consumption rates, crop water uses and evapotranspiration. The model uses Landsat (NDVI,) for the vegetation classification, impervious and pervious fraction values, NASA CRSP model in the study and a statistical analysis. The models will also standardize the features in the GIS to classify at a finer scale IKONOS data.

*How will this bring value to SMAP mission:*

- Combine remote sensing data products for improved urban modeling.
- Collaboration with user communities that uses SMAP data for urban development planning and decision-making.

- **CAP-LTER - Milan Shrestha**

- CAP-LTER (the Central Arizona Project, Long Term Ecological Research Project) is focused on the integration of science products into policy decisions; therefore CAP-LTER will be an end user for the SMAP mission data model products. CAP-LTER has over 200 different monitoring points for land cover and water monitoring in the Phoenix Active Management Area. Phoenix LTER is the largest group of all the LTERs and has both resources and variability for different soil moisture applications. CAP-LTER has extensive experience in researching the various impacts of urbanization and looking at the fragmentation patterns of urbanized areas. A direct application of soil moisture data would be to use the observations for policy science in nitrogen and phosphorous cycle studies. The research would focus on what are the consequences of urbanization in this area. By looking at different models that tie into the southwest water policy and incorporate the best observations in order to produce model data that will improve the water management decisions for the SW region.

Policy relevant applications such as single-family housing and the policy for city expansion projects of each city would be a focus. LTER would look at the drivers and do analysis of each one. The connection to SMAP mission would fall into fragmentation patterns and the ecosystem services by looking at these systems and how people make decisions.

*How will this bring value to SMAP mission:*

- Broaden the user community's uptake of remote sensing products.
- Integrate remote sensing products into policy and decision making forums

## **Focus session Outcomes and Summary**

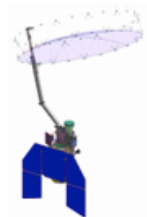
The SMAP focus session provided a forum for the ASU modeling group to receive specific support and information on the utility of SMAP soil moisture and freeze-thaw state products for their research objectives. The focus sessions concentration helped the SMAP Applications Team better understand what urban and hydrology modeling user community needed.

For modelers to be most effective with the integration of SMAP pre-launch test data, there is a need for:

- Access to algorithm reports and Cal/Val data (GLOW Sim).
- Data formats to be in netCDF and other GIS friendly formats (tiff, giff, etc) as opposed to only HDF4 and HDF5
- More involvement with algorithm and Cal/Val working groups.
- More product development: the use of Level 2 signal to make other products not defined by the SMAP mission
- Understanding of how SMAP data can be used with other data sets (i.e. solar radiation)
- Combining the SMAP data with ancillary soil texture data

Further discussion points for the SMAP Applications Team are:

- Inform NASA HQ and the DAACs of the user need in order to provide the appropriate resources (funding).
- Provide users with a data table that includes EASE grid format
- Provide more information on the availability and access to SMAP Cal/Val and SMAP EX data.
  - Release dates, locations and meta data



---

## SMAP Focus Session for Arizona State University's Modeling Community

Goals are to understand the:

- a) *Value of SMAP in relation to water resource management in world's dry regions;*
- b) *Format of the data and its delivery mechanism that is practical and useful for ASU's team to quickly use SMAP after its 2014 launch;*
- c) *Challenges and opportunities related to the use of SMAP data; and*
- d) *Explore possibilities for collaborative research between NASA and ASU.*

### Program outline

#### Day 1

Thursday, Feb 16, 2012

---

08:30-9:00	Coffee and refreshments
09:00	Welcome & Introduction – Netra Chhetri
09:10	SMAP Mission overview – Narendra Das
09:30	SMAP Applications Goals and Objectives - Susan Moran
<b>09:50</b>	<b>Break</b>
10:00	Individual Presentation from ASU participants ( <i>10-15 minutes each</i> ):
	<ul style="list-style-type: none"><li>• Water Resources and Policy (WaterSim)-<i>David Sampson</i></li><li>• Hydrology (tRIBS)- <i>Agustin Robles</i></li><li>• Climate Modeling-<i>U. Huang</i></li><li>• Fluid Dynamics-<i>Alex Mahalo</i></li><li>• Coupled land-surface model - <i>M. Georgescu</i></li><li>• LUCC-<i>Suo Myint</i></li><li>• CAP-LTER - <i>Milan Shrestha</i></li></ul>
10:30	SMAP Data Products- Barry Weiss
<b>12:00</b>	<b>Lunch (On Campus at ASU Dining Area)</b>
1:15	Working Discussion: SMAP data and models - Susan Moran
	<ul style="list-style-type: none"><li>• Identify the key roles for SMAP</li><li>• How the ASU modeling group can take advantage of the SMAP simulation data<ul style="list-style-type: none"><li>○ EA program and research</li></ul></li></ul>
<b>2:30</b>	<b>Break</b>
2:45	Recommendations for Engagement-discussion continued
	<ul style="list-style-type: none"><li>• Funding and collaborative opportunities.</li></ul>
4:00	Adjourn

## Day 2 Friday, Feb 17, 2012

---

- |             |   |
|-------------|---|
| 09:00       | Coffee and refreshments   |
| 09:30-11:00 | Internal discussion for opportunities and action items for SMAP related research. <ul style="list-style-type: none"><li>• Early Adopters for SMAP and other early launch efforts.</li></ul> |
| 11:00       | Concluding thoughts   |

*The SMAP Early Adopter program promotes applications research to provide a fundamental understanding of how SMAP data products can be scaled and integrated into organizations' policy, business and management activities to improve decision-making efforts. SMAP Early Adopters are defined as those groups and individuals who have a direct or clearly defined need for SMAP-like soil moisture or freeze/thaw data, and who are planning to apply their own resources (funding, personnel, facilities, etc) to demonstrate the utility of SMAP data for their particular system or model.*

*The goal of this designation is to accelerate the use of SMAP products after launch of the satellite by providing specific support to Early Adopters who commit to engage in pre-launch research that would enable integration of SMAP data in their applications.*

Please visit <http://smap.jpl.nasa.gov/science/wgroups/applicWG/> to apply for the next round of Early Adopters.

### Current funding and collaborative opportunities with ASU

- It's important to keep in mind that the applications feeding into the decision-making process start with identifying the societal needs. The early adopter process for the SMAP mission has the ability to connect SMAP science to research outcomes that would directly benefit society and add value to the mission
- The volumes of Ice in the Himalayas cause the albedo of the ice to change-increases the melting rate of the mountain ice. SMAP will help understand the melt of this Ice for studies.

Combining science and policy through think tanks in order to advance the uses of remote sensing data is important. Taking products from the scientist, communicate that product to the community and make a decision on that information is a strength at ASU and a collaboration with this focus will improve the quality of life.